MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 3, 2017/2018**

## EBM7011 – QUALITY SYSTEMS MANAGEMENT

(MScEBM)

06 JUNE 2018
10:00 a.m - 12:00 a.m
(2 Hours)

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**INSTRUCTION TO STUDENTS**

1. This Question paper consists of **13** pages, including cover page and the **Appendix**, with **2** sections. Attempt **ALL** questions.
2. **Section A** consists of Multiple Choice Questions. Write your answers on the Multiple Choice answer sheet given and attach it together with your answer Booklet of **Section B**.
3. **Section B** consists of descriptive and statistical questions. Provide your solutions on the answer Booklet given. Any graphs drawn on graph papers must be attached together with the anwer Booklet.

## SECTION A: Multiple Choice Questions, answer All (25 Marks)

1. A company incurred the following quality costs at the beginning of the year.
   Evaluating finished product $50,000
   Quality auditor training $15,000
   Manufacturability study $10,000
   Repairing finished product $15,000
   Process capability studies $30,000

   How much did the company spend on prevention costs?
   (a) $15,000
   (b) $55,000
   (c) $70,000
   (d) $120,000
   (e) $75,000

2. You are the Project Manager of a lithium cell manufacturing company. As part of Quality Control, you decide to check only 5% of the lithium cells generated for environmental check. Which technique are you using?
   (a) Pareto Diagram.
   (b) Control Charts.
   (c) Statistical Sampling.
   (d) Sample Selection.
   (e) Benchmarking.

3. The plan-do-study-act cycle is also known as the
   (a) TQM activity approach.
   (b) Deming wheel.
   (c) Continuous improvement cycle.
   (d) Quality circle.
   (e) Action wheel.

4. Just-in-time philosophy is applicable in all of the following, except:
   (a) Service organizations
   (b) Manufacturing organizations
   (c) Assembly line operations
   (d) Supermarkets
   (e) Education

5. One common definition of quality, which focuses on measuring how well the product or service meets targets and tolerances determined by its designers is.....
   (a) Fitness for use.
   (b) Value for price paid.
   (c) Technical perception.
   (d) Judgmental evaluation.
   (e) Conformance to specifications.

**Continued....**

6. The definition of quality that involves the product functioning as expected without failure is
   (a) Performance.
   (b) Conformance.
   (c) Reliability.
   (d) Standardization.
   (e) Endurance.

7. In six-sigma, the level of defects is reduced to approximately
   (a) 2.4 parts per million.
   (b) 1.4 parts per million.
   (c) 24.4 parts per million.
   (d) 3.4 parts per million.
   (e) 34.4 parts per million.

8. A six sigma team has been formed to improve an existing process. Which of the following tools should the team use first to gain a clear understanding of the current process?
   (a) Flowchart.
   (b) Pareto chart.
   (c) Process FMEA.
   (d) Taguchi Loss Function.
   (e) Check sheet.

9. When analyzing quality for a project, a Project Manager decides to use a tool. This tool provides a creative way to look at the causes or potential causes of a problem. Which tool is the Project Manager planning to use?
   (a) Pareto analysis.
   (b) Control chart.
   (c) Statistical sampling.
   (d) Ishikawa diagram.
   (e) Flow chart.

10. In SPC, p-chart is used to monitor the manufacturing process when
    (a) Only the number of defective items is known, but not the total samples.
    (b) The number of defective items and the total number of samples are known.
    (c) Changes in the mean of measured samples are to be monitored.
    (d) The standard deviation or variability of measured samples is to be monitored for improvement purposes.
    (e) Control charts for variables are not available.

**Continued....**

Questions 11 – 13 refer to the following information.

High Precision Ltd has a contract with MRD Sdn Bhd that requires semiannual, destructive testing of sample products. According to the contract, test results must be submitted to the customer to retain qualified supplier status, and the supplier must notify the customer when any of the samples fail testing. During a test cycle, some of the products fail, and the quality manager directs the quality engineer to reduce the number of samples tested by the number that failed so that the records will show that all samples passed the tests. The quality engineer documents the manager's orders, changes the test records, and ships the product. A short time later, both the quality engineer and the quality manager are laid off during a reorganization. Upper management subsequently hires a new quality engineer and contracts with an outside audit company to conduct an audit. In preparing for the audit, the new quality engineer discovers the falsified records.

11. What immediate action should the first quality engineer have taken after documenting the test failures?
    (a) Placed all products on hold and did a corrective action .
    (b) Had the test repeated by an external testing laboratory.
    (c) Negotiated a revised specification with the customer.
    (d) Retrained the employees who tested the products.
    (e) Had the failed samples reworked and retested.

12. How should the first quality engineer have responded to the quality manager's order?
    (a) Carried out the directive exactly as ordered.
    (b) Instructed someone else to perform the task.
    (c) Advised the manager of their potential adverse consequences.
    (d) Notified the customer anonymously.
    (e) Carried out a second test to confirm the first test results.

13. With respect to the falsified records, the new quality engineer is responsible for
    (a) Documenting as historical any events that took place prior to being hired at this company.
    (b) Documenting the impact those records will have on future product.
    (c) notifying management and recommending that the customer be contacted promptly.
    (d) Re-running the tests to see whether similar failures Occur.
    (e) Initiating an immediate conformance audit of the production process.

14. The following quality gurus are matched with their best known contributions to quality, except
    (a) Walter Shewhart – PDCA cycle
    (b) Kaoru Ishikawa – Cause and Effect diagram
    (c) Deming – 14-Points for management
    (d) Philips Colby – quality is free
    (e) Joseph Juran – Juran Methodology

**Continued....**

15. In statistical quality control, variation in the production process leads to:
    (a) Quality defects.
    (b) Process improvement opportunities.
    (c) Quality improvements.
    (d) Product consistency.
    (e) Service improvements.

16. For the standard normal distribution, how much confidence is provided within 2 standard deviations above and below the mean?
    (a) 97.22%
    (b) 95.44%
    (c) 99.74%
    (d) 99.87%
    (e) 90.00%

17. For the standard normal distribution, how much confidence is provided within 3 standard deviations above and below the mean?
    (a) 97.22%
    (b) 95.44%
    (c) 99.74%
    (d) 99.87%
    (e) 90.00%

18. In statistical process control, what measures the central tendency of a set of data?
    (a) Coefficient of variation
    (b) Variance
    (c) Standard deviation
    (d) Mean
    (e) Range

19. What are the four most common control charts?
    (a) x-bar, R, p, c
    (b) x-bar, R, p, OC
    (c) x-bar, R, c, OC
    (d) x-bar, p, c, OC
    (e) R, p, c, OC

20. Upper and lower control limits are usually set at ± how many standard deviations from the mean?
    (a) 0.5
    (b) 1.0
    (c) 2.0
    (d) 3.0
    (e) 6.0

**Continued....**

21. The Six Sigma approach is organized around a _____ plan known as _____.
    (a) four step, PDAC
    (b) four step, DMAC
    (c) five step PDACR
    (d) five step DMAIC
    (e) five step, DMCRA

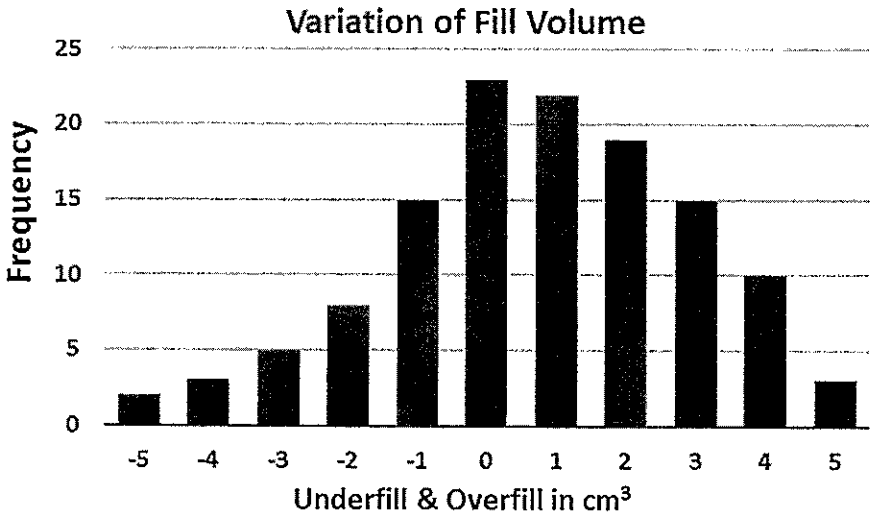
22. In six-sigma programs, individuals who have extensive training in the use of technical tools and are responsible for carrying out the implementation of Six Sigma are _____.
    (a) black belts
    (b) green belts
    (c) blue belts
    (d) red belts
    (e) white belts

23. For consumer products, an increase in the percentage of returned goods most likely equates to an increase in? – select only one which is the most relevance.
    (a) Product not meeting specifications
    (b) End-user dissatisfaction
    (c) Internal reject rates
    (d) Nonconforming material costs
    (e) Nonconforming cost of quality

24. Quality is:
    (a) Zero defects found
    (b) Conformance to requirements
    (c) The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs
    (d) (b) and (c)
    (e) All the above

**Continued....**

25. The Head of Quality Assurance Department has specified that a product must contain at least the volume printed on the label. He wants to reduce the amount of overfilled, the variation of which is shown in the chart below.




On the basis of the data above, what is the most effective strategy to accomplish this task?

(a) Decrease the target fill volume only
(b) Decrease the target fill variation only
(c) First, decrease the target fill variation, then decrease the target fill volume
(d) First, decrease the target fill volume, then decrease the target fill variation
(e) First, decrease the target fill variation, then increase the target fill volume

**Continued....**

# SECTION B

## Question 1

(a) As exemplified in the criteria for the Malcom Baldrige Quality Award, where leadership is given the highest point, describe why leadership is considered to be a crucial element in any change management and highlight its impacts in quality management programme. [5 marks]

(b) Joseph Juran's is well remembered for his contribution in process improvement methodology, which is an important concept in continuous improvement philosophy.

(i) Name this methodology and highlight its main components. [4 marks]

(ii) With the help of a proper diagram, describe how these components inter-relate with each other and how this inter-relationship embody the concept of continuous improvement. [7 marks]

(iii) For each of these components, describe its objective(s) and the activities(s) involved in realising this/these objective(s). [9 marks]

## Question 2

(a) One of the fundamental principles of Total Quality Management is the need to recognise that an activity is a *process*.

(i) With the help of a suitable diagram, show how the role of a process owner of an organisation changes from a *customer* to a *supplier*. [4 marks]

(ii) Show how the model drawn in Question 2(a)(i) links a supplier of the organisation with its eventual customers. [4 marks]

(b) There are two main aspects of implementing the Six Sigma Concept. The first is the use of technical tools and the second is people involvement.

(i) What are these tools and what is/are the main objective(s) of using these tools? [4 marks]

(ii) In terms of Six Sigma training and knowledge level, describe how people are classified. [4 marks]

(iii) The Six Sigma approach is organised around a plan known as the DMAIC. Using an appropriate diagram, describe what this DMAIC is and show how this concept and its steps are used continuously to search for quality improvement of manufactured products. [4 marks]

**Continued....**

(c) The ISO 9000 is a set of Quality Management System (QMS) standards that has its foundation on the Quality Management Principles (QMP). Identify these QMP and briefly provide the description and purpose of three (3) of these principles. [5 marks]

**Question 3**

(a) ABC Precision Metal Sdn Bhd has initiated a company-wide Six-Sigma initiative to improve the quality of its products, especially piston rods used in high performance engines. A Quality Audit team led by a Master Blackbelt has been formed, whose responsibility includes validating the quality assurance process by doing technical inspections. For the last two weeks, the Audit team with the support of Quality Control staff has taken 14 samples of 4 piston rods each, to determine the measurement compliance. The data and the computed means of the rod are as shown in Table Q3. If the standard deviation of the measurement is 0.26cm, use this information to:

(i) Complete **Table Q3** by calculating the remaining sample mean and mean range of the samples [4 marks]

(ii) Develop the control limits of 3 standard deviations for both x-bar chart and R-chart of the manufacturing operation. [8 marks]

(iii) Plot the x-bar chart showing both UCL and LCL lines. [4 marks]

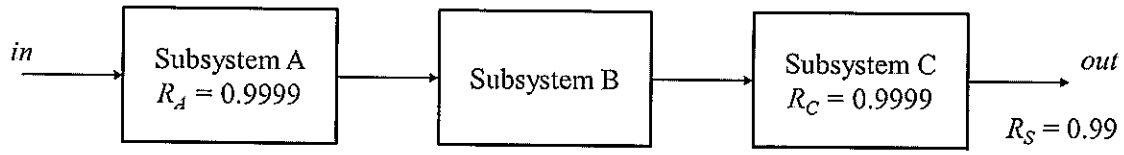
(iv) Plot the R-chart graph showing UCL and LCL lines. [4 marks]

| **Sample Number** | **Piston rod Measurement in cm** | | | | **Mean (cm)** | **Range (cm)** |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | $\bar{\bar{X}}$ | **R** |
| 1 | 15.92 | 15.96 | 15.81 | 15.33 | 15.76 | 0.63 |
| 2 | 15.90 | 15.78 | 16.29 | 15.97 | 15.99 | 0.51 |
| 3 | 16.02 | 15.38 | 15.40 | 15.83 | 15.66 | 0.64 |
| 4 | 15.83 | 15.66 | 16.03 | 15.61 | 15.79 | 0.42 |
| 5 | 15.86 | 15.64 | 15.92 | 16.22 | 15.91 | 0.59 |
| 6 | 15.99 | 16.23 | 15.83 | 15.74 | 15.95 | 0.49 |
| 7 | 15.60 | 15.37 | 15.83 | 16.10 | | |
| 8 | 16.08 | 15.58 | 15.65 | 15.52 | | |
| 9 | 15.99 | 15.53 | 16.25 | 15.62 | | |
| 10 | 16.02 | 15.71 | 15.85 | 15.73 | | |
| 11 | 15.69 | 16.26 | 15.94 | 16.12 | | |
| 12 | 15.48 | 15.92 | 15.60 | 15.48 | | |
| 13 | 16.00 | 15.33 | 15.60 | 16.24 | | |
| 14 | 16.12 | 15.64 | 16.12 | 16.06 | | |
| Mean | | | | | $\bar{\bar{X}}=$ | $\bar{R}=$ |

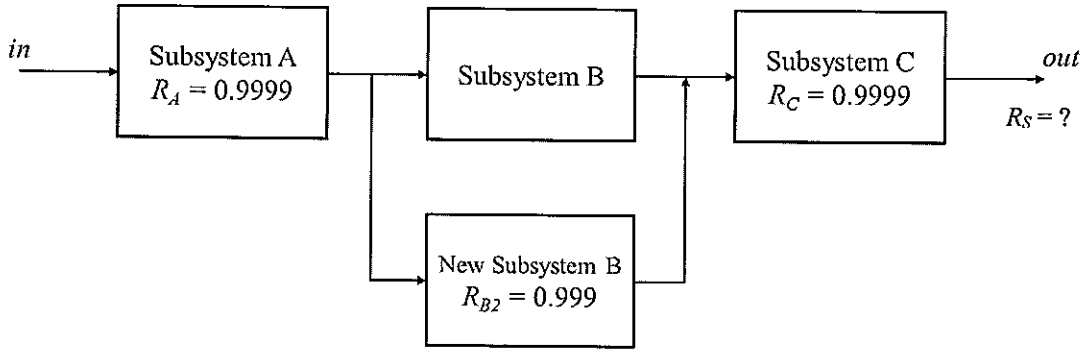
**Table Q3**

**Continued....**

(b) For a production system represented by the diagram below, calculate the reliability of Subsystem B if the overall reliability of the production system, $R_S$ is estimated to be 0.99. [2 marks]




To improve the reliability of Subsystem B, a similar subsystem with a reliability figure of 0.999 is connected in parallel as shown below. Calculate the new reliability of the entire system. [3 marks]

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# Appendix

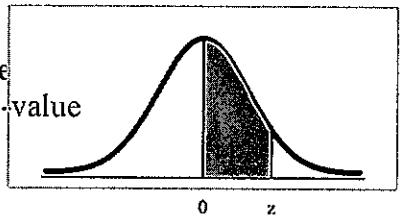
## Relevant Equations

| | | | |
|---|---|---|---|
| 1 | $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ | $\sigma_{(x)} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}$ | $\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$ |
| 2 | $\mathrm{UCL}_{(\bar{x})} = \bar{\bar{x}} + z\sigma_{\bar{x}}$ | $\mathrm{LCL}_{(\bar{x})} = \bar{\bar{x}} - z\sigma_{\bar{x}}$ | $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ |
| 3 | $\mathrm{UCL}_{(R)} = \bar{\bar{x}} + A_2\bar{R}$ | $\mathrm{LCL}_{(R)} = \bar{\bar{x}} - A_2\bar{R}$ | - |
| 4 | $\mathrm{UCL}_{(R)} = D_4\bar{R}$ | $\mathrm{LCL}_{(R)} = D_3\bar{R}$ | - |
| 5 | $\mathrm{UCL}_{(P)} = \bar{p} + z(\sigma_p)$ | $\mathrm{LCL}_{(P)} = \bar{p} - z(\sigma_p)$ | $\sigma_p = \sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$ |
| 6 | $\mathrm{UCL}_{(c)} = \bar{c} + z\sigma_c$ | $\mathrm{LCL}_{(c)} = \bar{c} - z\sigma_c$ | $\sigma_c = \sqrt{\bar{c}}$ |
| 7 | System Reliability | $R_{SP}(t) = 1 - \prod_{i=1}^{n}[1 - R_i(t)]$ | $R_{SS}(t) = R_1 \times R_2 \times R_3 \times .....R_n$ |

## Table of Factors for 3-Sigma Control Limits of *x*-chart and *R*-chart

| Observations in Sample (n) | $D_3$ | $D_4$ |
|---|---|---|
| 2 | 0 | 3.267 |
| 3 | 0 | 2.574 |
| 4 | 0 | 2.282 |
| 5 | 0 | 2.114 |
| 6 | 0 | 2.004 |
| 7 | 0.076 | 1.924 |
| 8 | 0.136 | 1.864 |
| 9 | 0.184 | 1.816 |
| 10 | 0.223 | 1.777 |
| 11 | 0.256 | 1.744 |
| 12 | 0.283 | 1.717 |
| 13 | 0.307 | 1.693 |
| 14 | 0.328 | 1.672 |
| 15 | 0.347 | 1.653 |

**TABLE A: The STANDARD NORMAL DISTIBUTION Table**
"Cell" entries are areas under the N(0,1) curve between 0 and the z-value




NOTE: In calculating a z-value before entering these tables, always round correctly to two places of decimal.

| 0.0000 | 0.0100 | 0.0200 | 0.0300 | 0.0400 | 0.0500 | 0.0600 | 0.0700 | 0.0800 | 0.0900 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1000 | 0.0398 | 0.0438 | 0.0478 | 0.0517 | 0.0557 | 0.0596 | 0.0636 | 0.0675 | 0.0714 | 0.0753 |
| 0.2000 | 0.0793 | 0.0832 | 0.0871 | 0.0910 | 0.0948 | 0.0987 | 0.1026 | 0.1064 | 0.1103 | 0.1141 |
| 0.3000 | 0.1179 | 0.1217 | 0.1255 | 0.1293 | 0.1331 | 0.1368 | 0.1406 | 0.1443 | 0.1480 | 0.1517 |
| 0.4000 | 0.1554 | 0.1591 | 0.1628 | 0.1664 | 0.1700 | 0.1736 | 0.1772 | 0.1808 | 0.1844 | 0.1879 |
| 0.5000 | 0.1915 | 0.1950 | 0.1985 | 0.2019 | 0.2054 | 0.2088 | 0.2123 | 0.2157 | 0.2190 | 0.2224 |
| 0.6000 | 0.2257 | 0.2291 | 0.2324 | 0.2357 | 0.2389 | 0.2422 | 0.2454 | 0.2486 | 0.2517 | 0.2549 |
| 0.7000 | 0.2580 | 0.2611 | 0.2642 | 0.2673 | 0.2704 | 0.2734 | 0.2764 | 0.2794 | 0.2823 | 0.2852 |
| 0.8000 | 0.2881 | 0.2910 | 0.2939 | 0.2967 | 0.2995 | 0.3023 | 0.3051 | 0.3078 | 0.3106 | 0.3133 |
| 0.9000 | 0.3159 | 0.3186 | 0.3212 | 0.3238 | 0.3264 | 0.3289 | 0.3315 | 0.3340 | 0.3365 | 0.3389 |
| 1.0000 | 0.3413 | 0.3438 | 0.3461 | 0.3485 | 0.3508 | 0.3531 | 0.3554 | 0.3577 | 0.3599 | 0.3621 |
| 1.1000 | 0.3643 | 0.3665 | 0.3686 | 0.3708 | 0.3729 | 0.3749 | 0.3770 | 0.3790 | 0.3810 | 0.3830 |
| 1.2000 | 0.3849 | 0.3869 | 0.3888 | 0.3907 | 0.3925 | 0.3944 | 0.3962 | 0.3980 | 0.3997 | 0.4015 |
| 1.3000 | 0.4032 | 0.4049 | 0.4066 | 0.4082 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4162 | 0.4177 |
| 1.4000 | 0.4192 | 0.4207 | 0.4222 | 0.4236 | 0.4251 | 0.4265 | 0.4279 | 0.4292 | 0.4306 | 0.4319 |
| 1.5000 | 0.4332 | 0.4345 | 0.4357 | 0.4370 | 0.4382 | 0.4394 | 0.4406 | 0.4418 | 0.4429 | 0.4441 |
| 1.6000 | 0.4452 | 0.4463 | 0.4474 | 0.4484 | 0.4495 | 0.4505 | 0.4515 | 0.4525 | 0.4535 | 0.4545 |
| 1.7000 | 0.4554 | 0.4564 | 0.4573 | 0.4582 | 0.4591 | 0.4599 | 0.4608 | 0.4616 | 0.4625 | 0.4633 |
| 1.8000 | 0.4641 | 0.4649 | 0.4656 | 0.4664 | 0.4671 | 0.4678 | 0.4686 | 0.4693 | 0.4699 | 0.4706 |
| 1.9000 | 0.4713 | 0.4719 | 0.4726 | 0.4732 | 0.4738 | 0.4744 | 0.4750 | 0.4756 | 0.4761 | 0.4767 |
| 2.0000 | 0.4772 | 0.4778 | 0.4783 | 0.4788 | 0.4793 | 0.4798 | 0.4803 | 0.4808 | 0.4812 | 0.4817 |
| 2.1000 | 0.4821 | 0.4826 | 0.4830 | 0.4834 | 0.4838 | 0.4842 | 0.4846 | 0.4850 | 0.4854 | 0.4857 |
| 2.2000 | 0.4861 | 0.4864 | 0.4868 | 0.4871 | 0.4875 | 0.4878 | 0.4881 | 0.4884 | 0.4887 | 0.4890 |
| 2.3000 | 0.4893 | 0.4896 | 0.4898 | 0.4901 | 0.4904 | 0.4906 | 0.4909 | 0.4911 | 0.4913 | 0.4916 |
| 2.4000 | 0.4918 | 0.4920 | 0.4922 | 0.4925 | 0.4927 | 0.4929 | 0.4931 | 0.4932 | 0.4934 | 0.4936 |
| 2.5000 | 0.4938 | 0.4940 | 0.4941 | 0.4943 | 0.4945 | 0.4946 | 0.4948 | 0.4949 | 0.4951 | 0.4952 |
| 2.6000 | 0.4953 | 0.4955 | 0.4956 | 0.4957 | 0.4959 | 0.4960 | 0.4961 | 0.4962 | 0.4963 | 0.4964 |
| 2.7000 | 0.4965 | 0.4966 | 0.4967 | 0.4968 | 0.4969 | 0.4970 | 0.4971 | 0.4972 | 0.4973 | 0.4974 |
| 2.8000 | 0.4974 | 0.4975 | 0.4976 | 0.4977 | 0.4977 | 0.4978 | 0.4979 | 0.4979 | 0.4980 | 0.4981 |
| 2.9000 | 0.4981 | 0.4982 | 0.4982 | 0.4983 | 0.4984 | 0.4984 | 0.4985 | 0.4985 | 0.4986 | 0.4986 |
| 3.0000 | 0.4987 | 0.4987 | 0.4987 | 0.4988 | 0.4988 | 0.4989 | 0.4989 | 0.4989 | 0.4990 | 0.4990 |

**Template for Question 3(a)**

(To be stapled together and submitted with the answer script, if used)

Student ID: | | | | | | | | | | |

| Sample Number | Piston rod Measurement in cm | | | | Mean (cm) | Range (cm) |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | $\bar{X}$ | R |
| 1 | 15.92 | 15.96 | 15.81 | 15.33 | 15.76 | 0.63 |
| 2 | 15.90 | 15.78 | 16.29 | 15.97 | 15.99 | 0.51 |
| 3 | 16.02 | 15.38 | 15.40 | 15.83 | 15.66 | 0.64 |
| 4 | 15.83 | 15.66 | 16.03 | 15.61 | 15.79 | 0.42 |
| 5 | 15.86 | 15.64 | 15.92 | 16.22 | 15.91 | 0.59 |
| 6 | 15.99 | 16.23 | 15.83 | 15.74 | 15.95 | 0.49 |
| 7 | 15.60 | 15.37 | 15.83 | 16.10 | | |
| 8 | 16.08 | 15.58 | 15.65 | 15.52 | | |
| 9 | 15.99 | 15.53 | 16.25 | 15.62 | | |
| 10 | 16.02 | 15.71 | 15.85 | 15.73 | | |
| 11 | 15.69 | 16.26 | 15.94 | 16.12 | | |
| 12 | 15.48 | 15.92 | 15.60 | 15.48 | | |
| 13 | 16.00 | 15.33 | 15.60 | 16.24 | | |
| 14 | 16.12 | 15.64 | 16.12 | 16.06 | | |
| Mean | | | | | $\bar{\bar{X}}=$ | $\bar{R}=$ |